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Determination of Theoretical Maximum Specific Gravity of Mixtures with Different Asphalt Contents

1. SCOPE

1.1 In designing a paving mixture with a given aggregate, the theoretical maximum specific gravity (Rice) at each asphalt content is needed to calculate the percentage of air voids for each asphalt content.

1.2 Use CT 309 to measure theoretical maximum specific gravity (Rice) in lieu of calculating maximum specific gravity in CT 367.

2. CALCULATION

2.1 For laboratory mix design, determine the theoretical maximum specific gravity at each asphalt content or determine the theoretical maximum specific gravity for at least two asphalt contents and calculate the average value. These values will be used in the effective specific gravity of aggregate equation, which will be used to calculate the theoretical maximum specific gravity of paving mixtures at different asphalt contents.

2.2 Use the following equation to calculate the effective specific gravity of aggregate:

$$G_{se} = \frac{100}{\frac{100 + P_b}{G_{mm}} - \frac{P_b}{G_b}}$$

Where:
G_{se} = effective specific gravity of aggregate (constant), to the nearest 0.001.
G_{mm} = maximum specific gravity of mixture (CT 309), to the nearest 0.001.
P_b = asphalt content, percent by mass of aggregate, to the nearest 0.1%.
G_b = specific gravity of asphalt (see Note on Figure 1 in CT 367), to the nearest 0.01.

Use the following equation to calculate the theoretical maximum specific gravity of paving mixtures at different asphalt contents:

$$G_{mm} = \frac{100 + P_b}{\frac{100}{G_{se}} + \frac{P_b}{G_b}}$$

3. EXAMPLE

Given:

Constituent or Paving Mixture	Specific Gravity	Composition – Percent by Mass of Total Aggregate
Asphalt Binder	1.02 (G_b)	5.0% and 5.5% (P_b)
Maximum Specific Gravity of Mixture at 5.0% Binder Content	2.535 (G_{mm})	
Maximum Specific Gravity of Mixture at 5.5% Binder Content	2.512 (G_{mm})	

Calculate:

G_{se} at 5.0% Asphalt Binder Content:

$$G_{se} = \frac{100}{\frac{100 + P_b}{G_{mm}} - \frac{P_b}{G_b}} = \frac{100}{\frac{100 + 5.0}{2.535} - \frac{5.0}{1.02}} = 2.738$$

G_{se} at 5.5% Asphalt Binder Content:

$$G_{se} = \frac{100}{\frac{100 + P_b}{G_{mm}} - \frac{P_b}{G_b}} = \frac{100}{\frac{100 + 5.5}{2.512} - \frac{5.5}{1.02}} = 2.732$$

Average G_{se} = 2.735

G_{mm} at 4.5% Asphalt Binder Content:

$$G_{mm} = \frac{100 + P_b}{\frac{100}{G_{se}} + \frac{P_b}{G_b}} = \frac{100 + 4.5}{\frac{100}{2.735} + \frac{4.5}{1.02}} = \underline{\underline{2.550}}$$

G_{mm} at 6.0% Asphalt Binder Content:

$$G_{mm} = \frac{100 + P_b}{\frac{100}{G_{se}} + \frac{P_b}{G_b}} = \frac{100 + 6.0}{\frac{100}{2.735} + \frac{6.0}{1.02}} = \underline{\underline{2.497}}$$